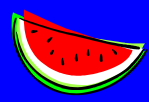



Sprouts, Salads and Ciders: The Growing Challenge of Fresh Produce-associated Foodborne Infections

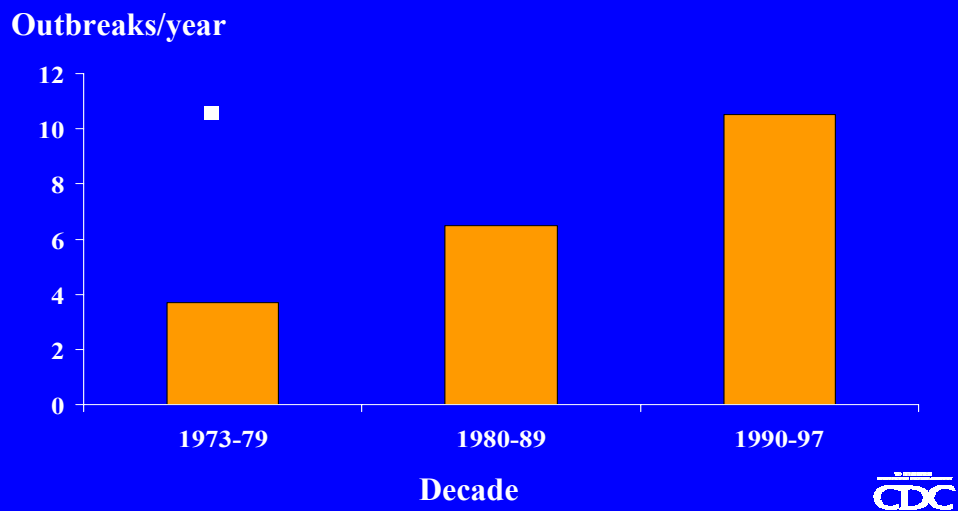




Colleen Crowe, MPH
Foodborne and Diarrheal Diseases Branch
Centers for Disease Control and Prevention

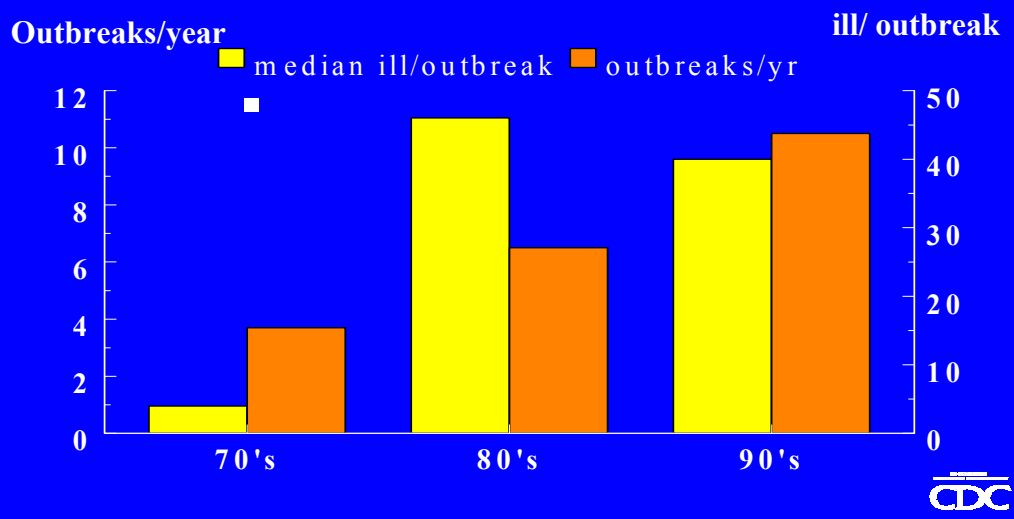
CDC

Number of fresh produce-associated outbreaks by decade, 1973-1997



CDC

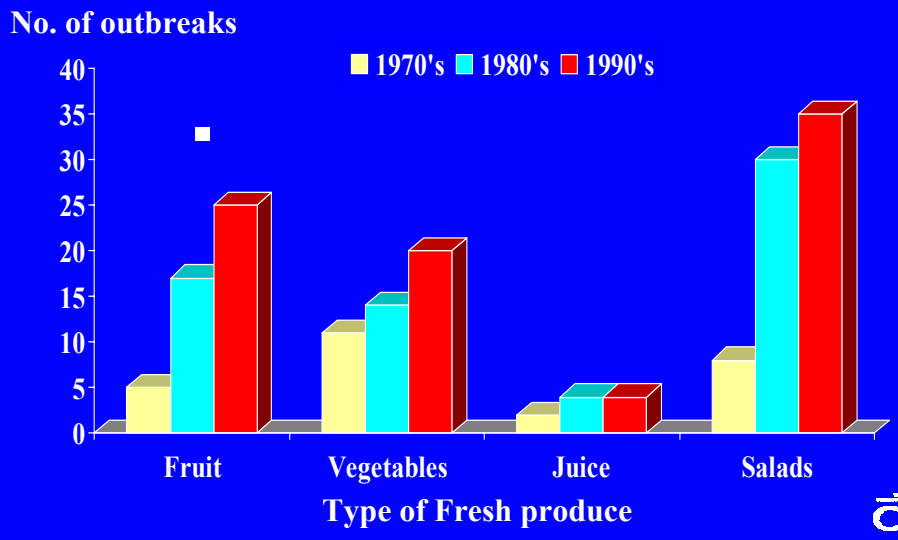
Characteristics of foodborne outbreaks



Foodborne outbreaks due to fresh produce by specific etiology

	1970's	1980's	1990's	Total
Salmonella	4	7	18	29
Other bacterial	2	5	6	13
Shigella	-	9	2	11
Hepatitis A	1	5	4	10
E. coli O157:H7	-	-	9	9
Norwalk/like	1	3	1	5
Giardia	-	2	3	5
Cyclospora		-	5	5
Other viral	-	-	1	1
Unknown	18	34	38	90
Total	26	65	84	178

Foodborne outbreaks due to fresh produce by specific vehicle, N=175



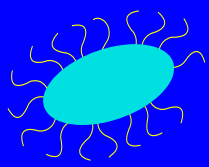
A growing public health problem

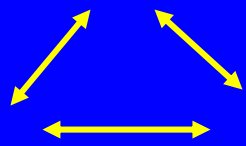
- Reported outbreaks per year have tripled since the 1970's
- Outbreaks have increased more then 10x in size
  - Suggesting that increase in number of outbreaks is not just due to better reporting
- More recent outbreaks are due to *Salmonella, E coli* O157: H7 and Cyclospora
- More outbreaks are due to fruit and salads

The possibilities…..

HOSTS

MICROBES





ENVIRONMENT

Microbe factors

- **Emerging pathogens**
  - **Cyclospora**
- **Recognition of acid tolerant organisms**
  - ***E. coli* O157**

Host Factors

- Increased consumption
  - Per capita consumption up 23% from 1970 to 1996
  - Dietary guidelines promote increased consumption
- New foods have become popular
  - Sprouts, fresh juice smoothies
- Convenience foods available
  - Pre-cut melons, shredded lettuce

Environmental factors

- Globalization of food supply
- Mass production and distribution
- Changes in farming and processing practices

Complex chain for produce from farm to table

Process	Handling	Environment
Production & harvest	Growing, harvesting	Animals, irrigation water, manure, field sanitation
Initial processing	Washing, waxing, sorting, boxing	Wash water
Distribution	Trucking	Ice, dirty trucks, other foods
Final processing	Slicing, squeezing, shredding, peeling	Wash water, cross-contamination, time and temperature

→ Consumption

CDC

Examples of fresh-produce associated outbreaks

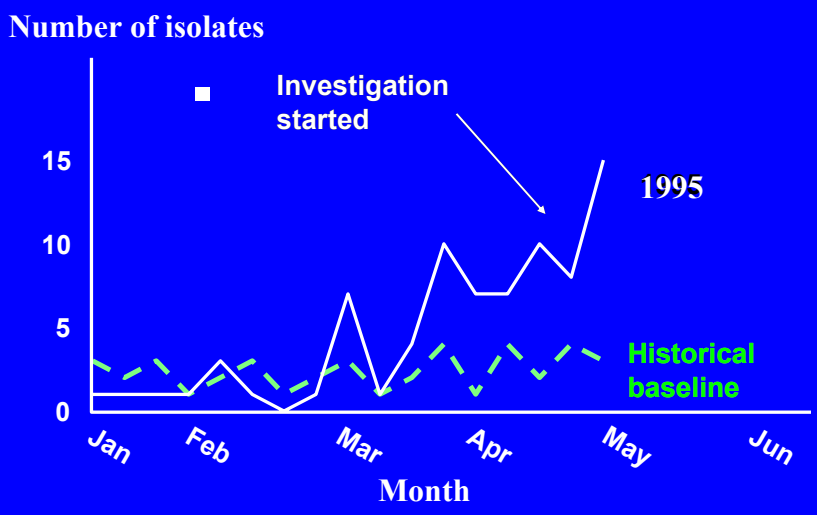
- Sprouts
- Unpasteurized juice

CDC

Examples of fresh produce-associated outbreaks

- ✓Sprouts
  - 20 known outbreaks worldwide since 1973
  - 15 *Salmonella*, 4 *E coli*, 1 *B. cereus*
  - 15/20 in N. America
  - 14/15 since 1995

Salmonella serotype Stanley: All United States, Jan - May 1995



Salmonella Stanley, Traceback - 1995

United States

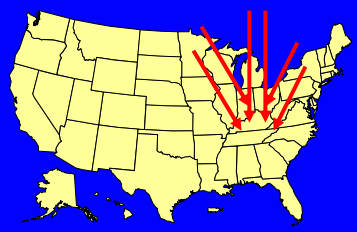
50 cases in 6 states

↓

9 alfalfa sprout growers

↓

1 U.S. seed supplier



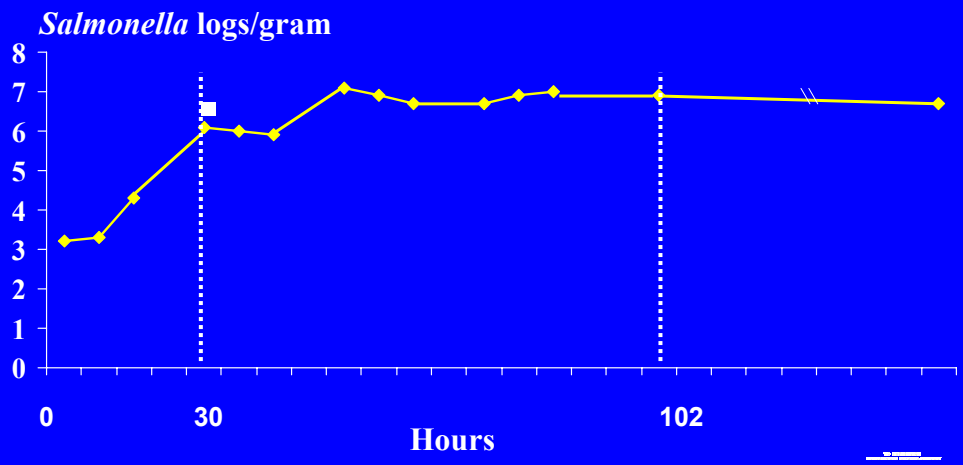
International

96% of U.S. patients ate sprouts grown from alfalfa seed from shipper in Netherlands

Same shipper supplied Finland

CDC

Rapid growth of *Salmonella* Stanley during sprouting of alfalfa seeds



CDC

Jaquette et al. Appl Env Microbiol, 1996

Sprouts: prevention challenge

- Point of contamination: Pre-sprouting
- Known barriers to contamination: None
- Potential for growth and survival: Survival on seeds and growth during sprouting
- Possible solutions:
  - Improve hygiene on those few farms that grow seed for human consumption
  - Treat seeds before sprouting – irradiation? chlorine? heat?
  - High risk groups should avoid sprouts

Examples of fresh-produce associated outbreaks

✓Unpasteurized juice

- 12 known outbreaks since 1974
- 9 from Apple juice or cider, 3 from Orange juice
- Organisms: *E. coli* O157, *Cryptosporidium*, *Salmonella*

Orange juice after 1999

Type	Fruit	Juice extracted	Warning label on finished product
Pasteurized/ from concentrate		 Kill step	No
Raw			Yes
"Fresh squeezed" unpasteurized	 Kill step		No

Orange juice outbreaks due to *Salmonella*

Year	Location	# ill	Product	Type of processing	Source of contamination
1995	Theme park A Florida	62	"Fresh squeezed" juice	Raw/ untreated	Pre-harvest or processing
1999	20 states Canada	423	"Fresh squeezed" smoothies	Pre-extraction kill step	Production or transport
2000	8 states	88	"Fresh squeezed juice", free samples	Pre-extraction kill step	Unknown

Unpasteurized juice: prevention challenge

- Point of contamination: Preharvest (irrigation water, animal feces), during transport or processing
- Known barriers to contamination: Heat
- Potential for growth and survival: Survival below pH of 4.0 and with refrigeration
- Possible solutions:
  - Pasteurization
  - Alternative terminal kill step
  - Clear warning labels for all unpasteurized juice

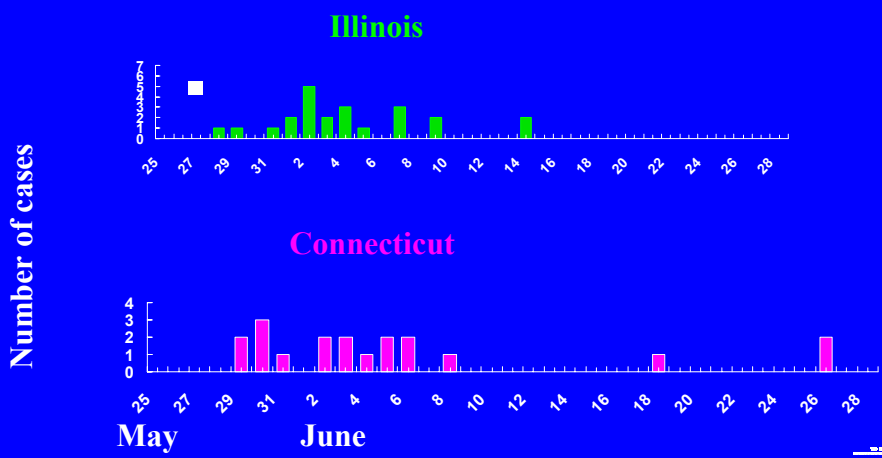
CDC

Imported or Domestic

Does it matter?

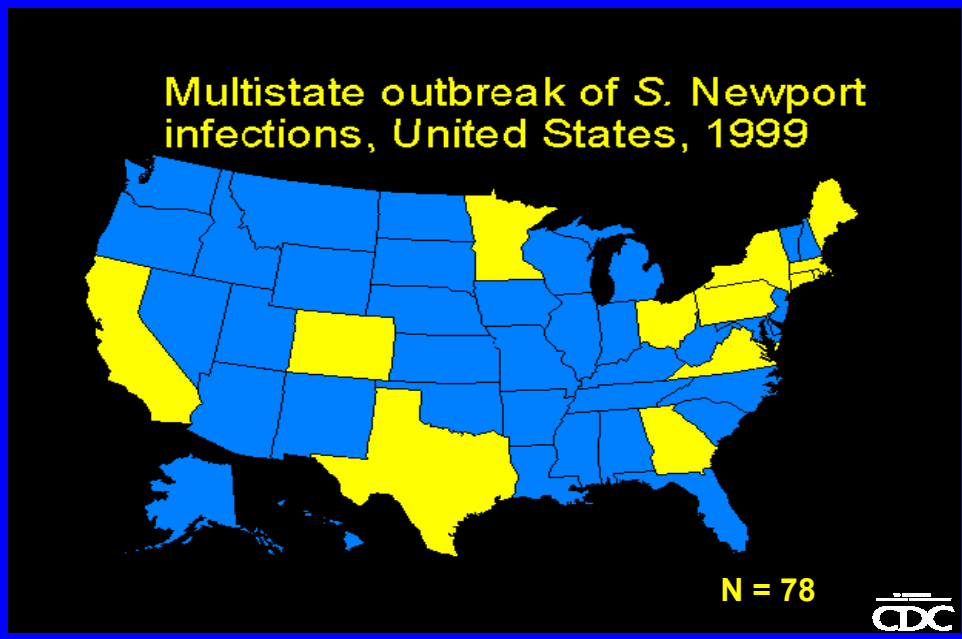
CDC

E. coli O157:H7 Infections, Illinois and Connecticut, May - June, 1996



E. coli O157:H7, Illinois and Connecticut, 1996 Mesclun mix

- Traceback implicated one grower in California
- Results of follow-up investigation
  - Lettuce grown near cattle ranches
  - Wash water recycled
  - Processing shed open to environment

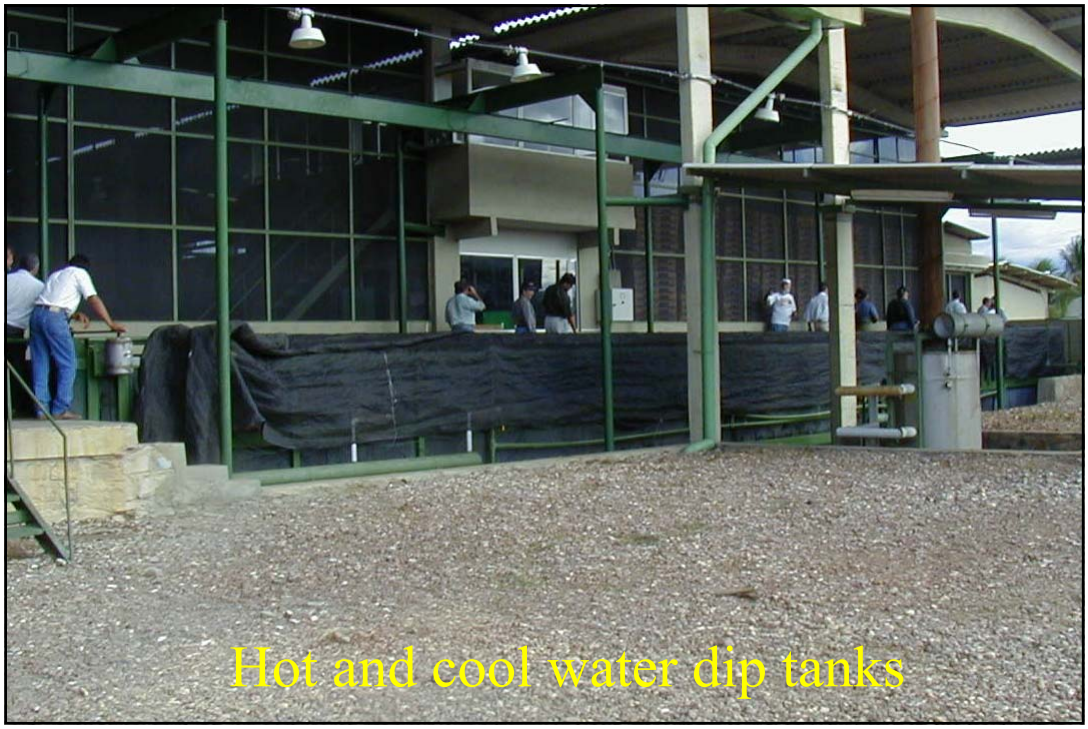


Traceback investigation

Mangos purchased in grocery stores in:

- **Pennsylvania**
- **Massachusetts**
- **Colorado**

CDC



Hot and cool water dip tanks

The prevention challenge

- Washing by consumers only reduces contamination by 10^1 or 10^2 organisms
  - Surface is complex and difficult to clean
  - Pathogens may adhere tightly
  - Contamination may be internal
- Once surface integrity is broken, growth can be rapid
  - Refrigeration often not standard practice
  - "Pre processing" means more growth opportunities
  - Increasing time between "pre processing" and consumption

CDC

Conclusions

- Fresh produce-associated outbreaks have increased in past 3 decades
- There are many food and pathogen combinations
- There are many possible points of contamination
  - Harvesting, initial processing, distribution and final processing
- Domestic and imported produce have caused outbreaks
- Contamination is easier to prevent than to wash off
- Additional barriers or prevention steps are needed before, during, and after processing

CDC

New prevention measures for fresh produce as a result of outbreak investigations

- Sprouts
  - Interim recommendations for seed treatment
  - Research being actively conducted on possible pre-sprouting control steps (e.g. chlorination of seeds)
- Juice
  - New labeling regulations
  - Some raw juice makers switched to pasteurization
- Lettuce
  - Lettuce industry undertaking steps to improve sanitation during processing
- Mangos
  - Farm in Brazil now has in-line chlorination
  - Better sanitation being promoted on mango farms worldwide

CDC

Challenges for the future

- **Public Health officials**
  - **Continue to identify problems**
  - **Early detection, reporting, and investigation**
- **Regulatory agencies and industry**
  - **Identify safe production standards and implement them**

Enhanced Surveillance through MDP Program

- Planned Sample Design
  - Likely representativeness
  - Provide information to explain sporadic cases
- Serotyping of isolates
- Enhanced research on pathogen resistance

CDC's Use of MDP Program Results

- May provide possible links between foodborne illness and produce sources
  - ➢Use information in conduct of outbreak investigations
  - ➢Use information in conduct of sporadic disease case-control studies
- Provide for the advancement in laboratory methods in food testing

Acknowledgements

Cindy Friedman
Sumathi Sivapalasingham
Josefa Rangel
Ellen Steinberg
Barbara Mahon
Larry Slutsker
John Brooks
Jono Mermin
Betsy Hilborn
Kim Cook
Paul Mead
Patricia Griffin
Robert Tauxe
PulseNet Team
FDA
Many State Health departments